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Oak Ridge National Laboratory

Health Physics Division

VALIDITY OF WIND DIRECTION DATA

(ASI-520-49)

April 19, 1949

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April 19, 1949

ASI-520-49

Validity of Wind Direction Data

After examining the records of wind data taken at X-10 for the period January 1946 to March 1949, it appears that the validity of a portion of the wind direction data is questionable.

The period of questionable data dates back to the Spring of 1947 and continues to the Fall of 1948. During this period the data shown for the directions East, Northeast, North, Northwest, and West are not valid. This appears to have been caused by the failure or the partial failure of the North contact on the wind vane. A check on the mechanics of the wind vane shows that the failure of the North contact would result in a Northeast wind being recorded as East and a Northwest wind being recorded as West. This would mean that during this period the percentage shown for East winds is in reality the sum of the East and Northeast winds. The same would apply to the West and Northwest winds.

The above conclusions are further borne out by the data shown on the attached graphs, No. 1 and No. 2. Graph No. 1 shows the per cent of East winds, the per cent of Northeast winds, and the sum of the percentages of East and Northeast winds for the period January 1946 to March 1949. Graph No. 2 shows similar data for West and Northwest winds for the same period.

Reference to Graph No. 1 shows that the graph of the sum of the East and Northeast winds follows the expected seasonal variations for the entire period shown while the percentages of East and Northeast winds follow the expected seasonal variations only through March 1947 then deviate markedly from the normal. The per cent of East winds rises sharply and closely parallels the graph of the sum of East and Northeast for the remainder of 1947 and through September 1948. Conversely the per cent of Northeast winds falls sharply and remains very low during the same period.

Reference to Graph No. 2, likewise shows that similar reasoning may be applied to the Northwest and West winds. This is in keeping with the hypothesis stated previously that the North contact of the wind vane failed intermittently during the period in question.

Assuming that the foregoing conclusions were correct, wind rose data for 1947 and 1948 were prepared.

In the following calculations these assumptions are made:

1. That the observed percentage of winds from the North is incorrect.
2. That the observed percentages for the directions Southeast, South, and Southwest are correct.
3. That the observed percentages of East and Northeast winds taken separately are incorrect but taken together their sum is a true observation of East and Northeast winds.
4. That the observed percentages of West and Northwest winds taken separately are incorrect but taken together their sum is a true observation of West and Northwest winds.
5. That the deviations of the 1947 and 1948 Knoxville data from the Knoxville normal data is applicable to data taken at X-10.

Based on the above assumptions, the sum of the observed East and Northeast winds at X-10 for 1947 and 1948 was apportioned between East and Northeast and the sum of the West and Northwest winds was apportioned between West and Northwest. This division of the sums was made on the basis of the applicable percentages of the X-10 normal data after these percentages had been corrected for the deviation of the 1947 and 1948 Knoxville data from the normal Knoxville data (assumed to be applicable to X-10).

The percentage of North winds was extrapolated from the 1947 and 1948 Knoxville data using the relation between the percentage of North winds in the X-10 normal* and in the Knoxville normal** data.

The results of the above calculations give a total of 98% for the eight cardinal points of the compass for 1948 and a total of 99.7% for the year 1947. The individual percentages are in good agreement with previous climatological records.

Calculations, results and annual wind roses of direction and velocity for 1947 and 1948 are attached.

W. D. Cottrell
W. D. Cottrell

WDC:cs

*Knoxville normal data based on period 1939-1948.

*X-10 normal data based on period July 1944 to July 1945 (period during which data from X-10 is the most complete).

Knoxville data furnished through courtesy Knoxville Office of U.S.W.B.

1947 Data

Because of the unusually high percentage of lost data in 1947, it is necessary to first extrapolate a normal annual percentage of North winds for X-10 and then correct the percentages for the other directions accordingly.

$$\frac{1947 \text{ Knoxville North}}{\text{Normal Knoxville North}} \times \text{normal X-10 North} = 1947 \text{ X-10 North}$$

$$\frac{9.0}{7.9} \times 6.8 = 7.8\% \text{ North for X-10, 1947.}$$

Assuming that 7.8% of the time the wind was from the North and that the North contact was out of order, this percentage (7.8%) would have been included in the per cent of missing data. Since the other seven average directional frequency percentages were calculated on the basis of the actual hours of data recorded they would be high by 6.5%. This was arrived at as follows:

Actual time elapsed, 7320 hours (10 months)
 Actual time data recorded, 6374 hours
 Calculated time from north, $7.8\% \times 7320 = 439$ hours
 Total hours of data and calculated hours of North data = 6813 hours

If y = percentage calculated on basis of 6374 hours
 and y' = percentage calculated on basis of 6813 hours

$$\text{Then } \frac{y'}{y} = 93.5\%$$

The corrected observed values for X-10, 1947 are:

<u>Direction</u>	<u>Per cent</u>	
N	unreliable	
NE	3.2	E + NE = 39.8%
E	36.6	
SE	1.9	
S	6.5	W + NW = 19.7%
SW	24.0	
W	18.8	
NW	0.9	

We now have only to apportion the sum, E + NE, between the East and Northeast directions and the sum, W + NW, between the West and Northwest directions. This is done on the assumption that the ratios E/NE and W/NW are fairly constant and that the same relation exists between the X-10 1947 data and the X-10 normal data as exists between the Knoxville 1947 data and the Knoxville normal data.

Knoxville 1947 Data

<u>Direction</u>	<u>Per cent</u>	<u>Velocity(m.p.h.)</u>	
N	9.0	7.3	
NE	27.0	7.1	$\frac{E}{NE} = \frac{4.0}{27.0} = 0.15$
E	4.0	4.0	
SE	5.0	4.7	
S	5.0	7.0	
SW	29.0	10.0	
W	11.0	10.2	$\frac{W}{NW} = \frac{11.0}{7.0} = 1.57$
NW	7.0	5.9	
Indeterminate	3.0	1.0	

Knoxville Normal Data (complete data given elsewhere)

$$\frac{E}{NE} = 0.31 \quad \frac{W}{NW} = 2.02$$

X-10 Normal Data

$$\frac{E}{NE} = 0.30 \quad \frac{W}{NW} = 2.69$$

If the same relation exists between the X-10, 1947 and the X-10 normal as exists between the Knoxville 1947 and the Knoxville normal we get the following for X-10, 1947:

$$\frac{0.15}{0.31} \times 0.30 = 0.145 = \frac{E}{NE}$$

$$\frac{1.57}{2.02} \times 2.69 = 2.09 = \frac{W}{NW}$$

Applying the above relationships to the observed corrected data:

X-10, 1947

$$E + NE = 39.8\%$$

$$\frac{E}{NE} = 0.145$$

$$NE = 34.8\%$$

$$E = 5.0\%$$

$$W + NW = 19.7\%$$

$$\frac{W}{NW} = 2.09$$

$$NW = 6.4\%$$

$$W = 13.3\%$$

Validity of Wind Direction Data

Attachment 3b

As a result of the preceding manipulations we arrive at the following average annual directional frequency percentages for X-10, 1947:

<u>Direction</u>	<u>Per cent</u>
N	7.8
NE	34.8
E	5.0
SE	1.9
S	6.5
SW	24.0
W	13.3
NW	6.4
Total	99.3%

Validity of Wind Direction Data

Attachment 4

1948 Data

Knoxville 1939-1948

<u>Direction</u>	<u>Per Cent</u>	
N	7.9	
NE	25.1	$\frac{E}{NE} = \frac{7.8}{25.1} = .31$
E	7.8	
SE	5.3	
S	5.5	
SW	23.6	
W	14.7	$\frac{W}{NW} = \frac{14.7}{7.3} = 2.02$
NW	7.3	

X-10 July 1944 - June 1945

<u>Direction</u>	<u>Per Cent</u>	
N	6.8	
NE	26.1	$\frac{E}{NE} = \frac{7.9}{26.1} = .302$
E	7.9	
SE	3.0	
S	4.8	
SW	22.0	
W	20.7	$\frac{W}{NW} = \frac{20.7}{7.7} = 2.69$
NW	7.7	

Knoxville 1948

<u>Direction</u>	<u>Per Cent</u>	
N	12.0	
NE	25.0	$\frac{E}{NE} = \frac{4.0}{25.0} = .16$
E	4.0	
SE	5.0	
S	7.0	
SW	27.0	
W	10.0	$\frac{W}{NW} = \frac{10}{8.0} = 1.25$
NW	8.0	

Assuming the same relation exists between the X-10, 1948 and the X-10 normal as exists between the Knoxville 1948 and the Knoxville normal we get for X-10, 1948:

$$\frac{.16}{.31} \times .30 = .155 = \frac{E}{NE} \quad \frac{1.25}{2.02} \times 2.69 = 1.66 = \frac{W}{NW}$$

1948 X-10 Data As Observed

<u>Direction</u>	<u>Per Cent</u>	
N	4.3	
NE	5.6	$E + NE = 34.3\%$
E	28.7	
SE	5.8	
S	6.3	
SW	24.5	
W	16.1	$W + NW = 16.8\%$
NW	0.7	

If, as was previously assumed, the sums of E + NE and W + NW are correct as observed then we have:

$$E + NE = 34.3\%$$

$$\frac{E}{NE} = .155$$

$$NE = 29.8\%$$

$$E = 4.5\%$$

$$W + NW = 16.8\%$$

$$\frac{W}{NW} = 1.66$$

$$NW = 6.3\%$$

$$W = 10.5\%$$

If, as was further assumed, the directions S, SE, and SW are correct as recorded, we have only the North direction to be determined. This can best be done by extrapolating the 1948 Knoxville data to a normal annual value for X-10.

Knoxville Normal

$$N = 7.9\%$$

X-10 Normal

$$N = 6.8\%$$

1948 Knoxville

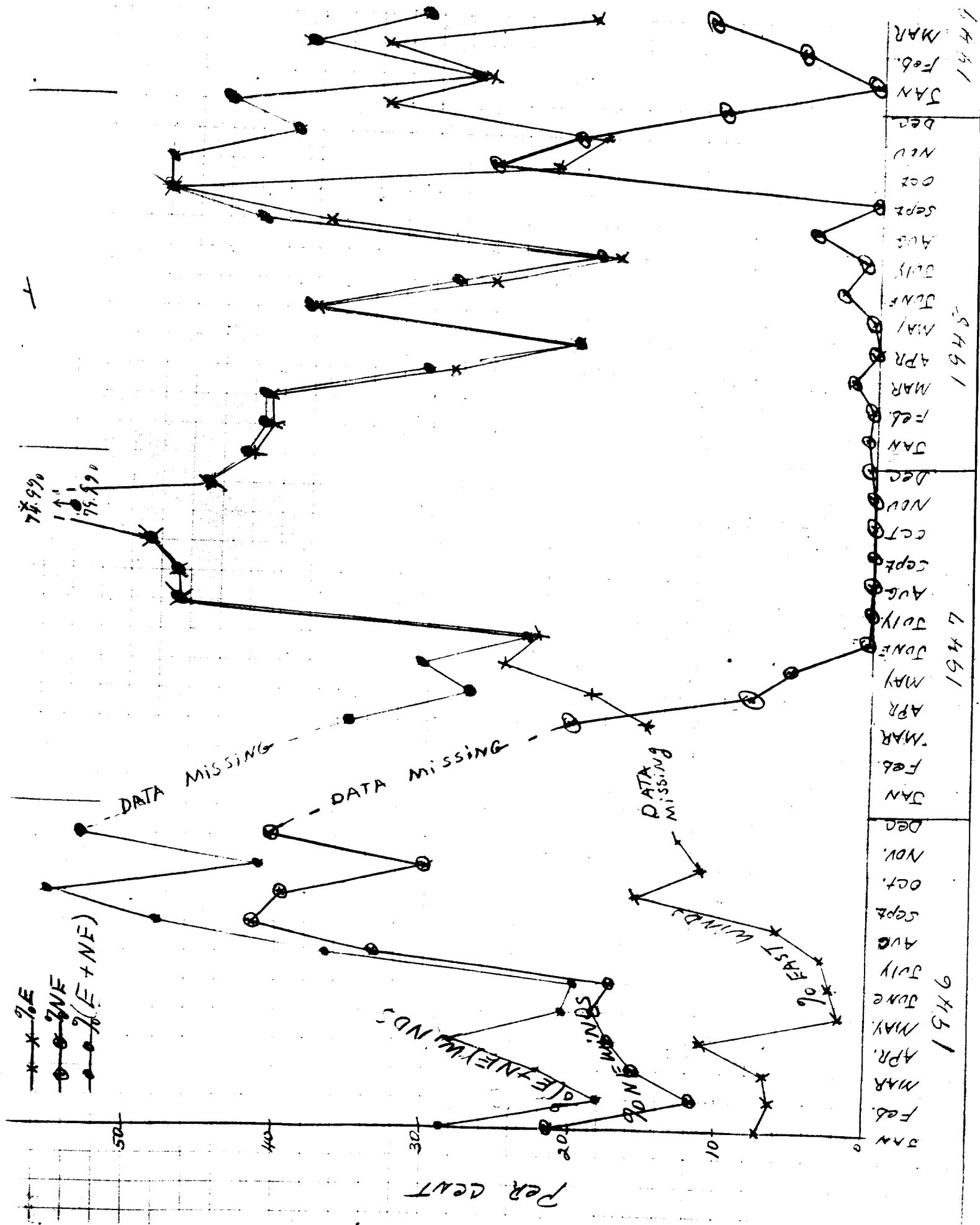
$$N = 12.0\%$$

$$\frac{6.8}{7.9} \times 12.0 = 10.3\% \text{ N 1948 X-10 Extrapolated}$$

As a result of weighting the observed values and extrapolating for a North percentage we get the following average direction frequency percentages for X-10 during the year 1948:

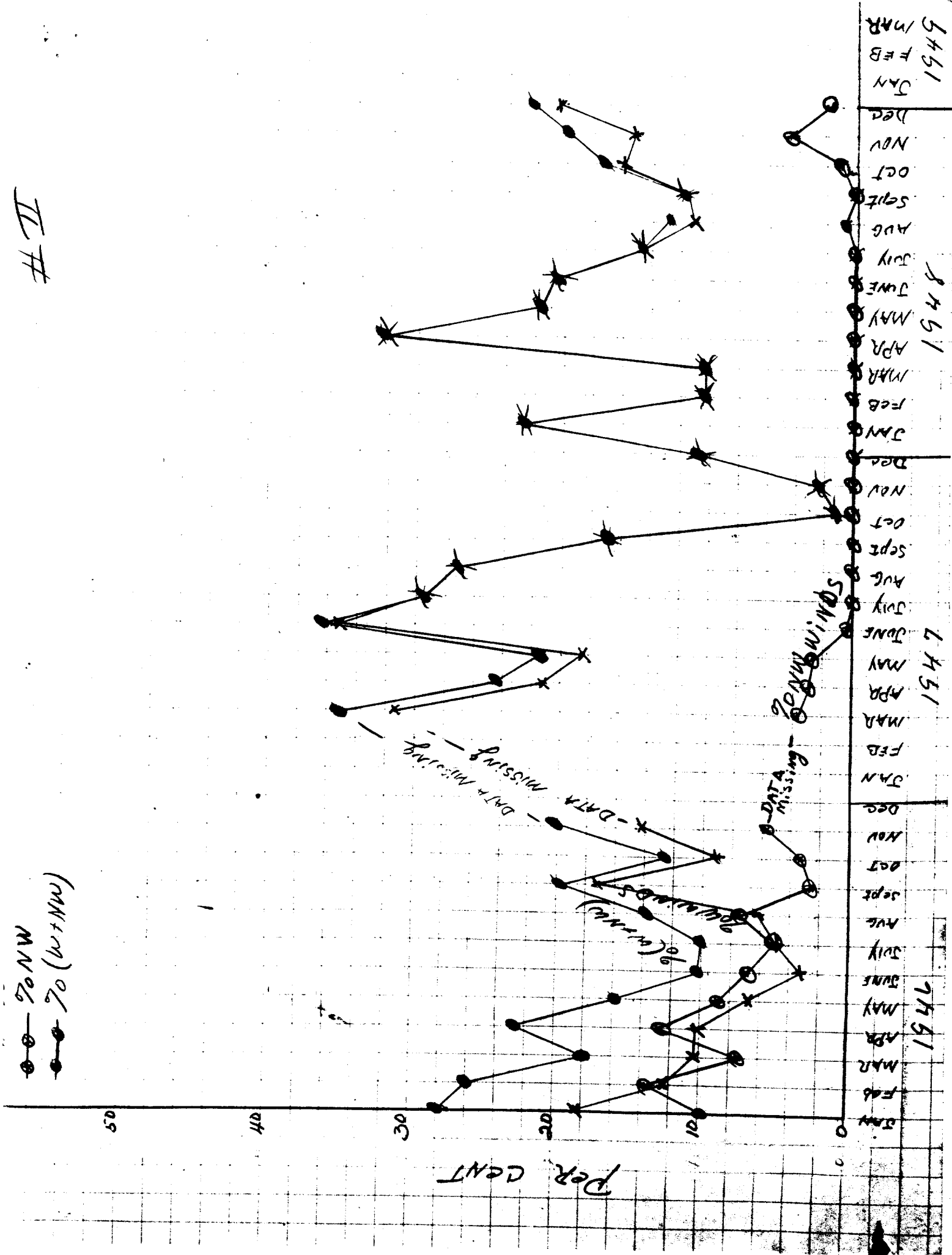
<u>Direction</u>	<u>Per Cent</u>
N	10.3
NE	29.8
E	4.5
SE	5.8
S	6.3
SW	24.5
W	10.5
NW	6.3
Total	98.0%

This leave 2% of the time during which the direction was indeterminate (calms, etc.). This is in good agreement with records of previous years.



○—○ 70NW
 ●—● 70(W+NW)

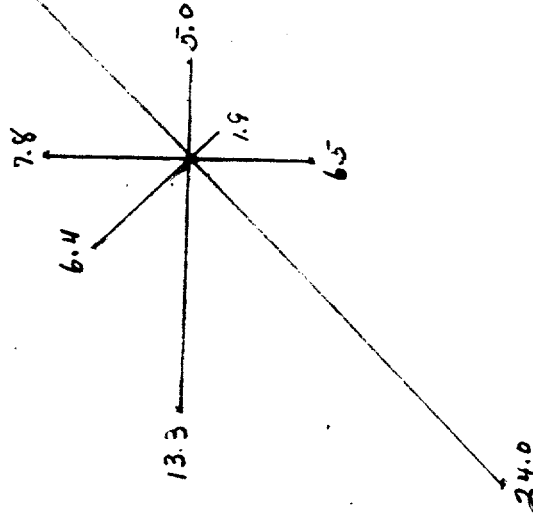
II #



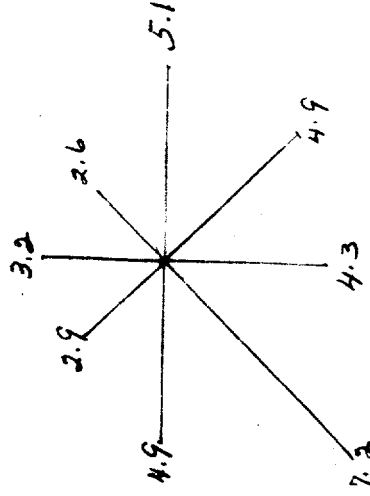
WIND ROSE

FEB-DEC 1947 (10 mos.)
X-10

34.8

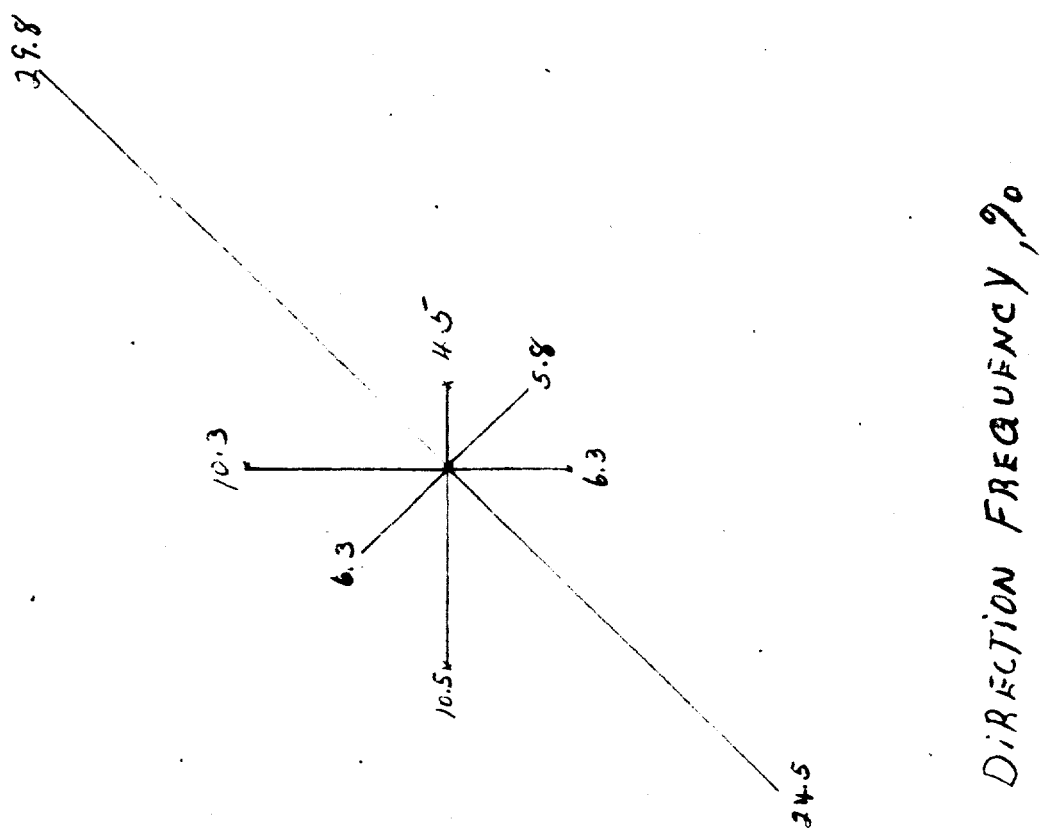


DIRECTION FREQUENCY, %



AVERAGE VELOCITY, MPH

ANNUAL WIND ROSE 1948 X-10



AVERAGE VELOCITY MPH